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<p>(54) Title: DENTAL FLOSSING DEVICE AND METHOD THEREFOR</p> <div data-bbox="462 1186 1242 1554"></div> <p>(57) Abstract</p> <p>An electro-mechanical dental flossing device (10) is disclosed for flossing the area between a portion of the tooth and the gum tissue. The device comprises an elongated member (22) coupled to a motor source (28) to effect oscillation of the elongated member. The elongated member (22) includes an intermediate portion (23) and a tip (25) which are capable of being received between the tooth and the gum tissue.</p>		

DENTAL FLOSSING DEVICE AND METHOD THEREFOR

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BACKGROUND OF THE INVENTION

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RELATED APPLICATIONS

This is a continuation in part of application Serial Number 08/093,188, filed on July 16, 1993, by Dane Q. Robinson, which is a continuation in part of U.S. patent application Serial Number 08/001,521 filed on January 7, 1993, by Dane Q. Robinson, now abandoned.

15

FIELD OF INVENTION

This invention generally relates to dental devices and methods, and, more specifically, to an electro-mechanical dental flossing device and method therefor which provides a hand held, electrically powered flossing tool having a tip comprised of a substantially thin, flexible member capable of being received between a tooth and the adjacent interdental papilla portion of the gum (the dental sulcus). The tip is oscillated to produce a flossing action.

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DESCRIPTION OF PRIOR ART

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The prior art provided various types of dental devices and methods for the cleaning of teeth as well as the massaging of the gum tissue. For example, U.S. Pat. No. Re. 30,536, "Ultrasonic Device and Method", issued on March 3, 1981 shows an apparatus which utilizes an ultrasonically driven head in conjunction with a spray of liquid or slurry containing abrasive material to operate as a cutting or cleaning tool in dental operations. As a second example, U.S. Pat. No. 4,913,133, "Hand Held Periodontic Tool", issued on April 3, 1990 discloses a hand held periodontic tool which vibrates a flexible tip for use in massaging gum tissue, but which cannot be used for dental flossing. Such prior art devices, however, are typically unable to reach the area between the portion of the tooth located beneath the gum tissue surface and the gum tissue itself (interdental papilla). This area was generally cleaned with dental floss.

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However, the use of dental floss can be somewhat cumbersome. In many instances there are contact areas between the teeth (i.e. portions of the crowns of the teeth are closely adjacent

or touching), typically at the top of the crown. In order for floss to be received between the teeth, it is generally necessary for the floss to be forced between the teeth from above, and must pass through any contact area. However, such contact areas often do not provide adequate space to permit passage of the floss. This tends to result in the floss shredding or breaking rather than
5 passing between the teeth. In such instances, some manner of threading device must be employed.

Devices which dispose a strand of floss between rigid arms of a forked or "U" shaped tip to facilitate flossing are available. Electrical flossing devices which reciprocate such a tip are
10 also known. An example of such a device is described in U.S. Patent 4,235,253, issued November 25, 1980, to D. A. Moore.

Thus, although the prior art discloses a variety of devices for the cleaning of the exposed surfaces of the teeth and for the massaging of the gum tissue, and devices to facilitate flossing,
15 there remains a need for a device to more effectively and efficiently clean or floss the area not only between the teeth, but also the area between the interdental papilla and the interproximal surface of the tooth.

SUMMARY OF INVENTION

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The present invention provides an improved electro-mechanical dental flossing device and method therefor which effectively and efficiently provides a flossing action both between and around teeth as well as providing a flossing action between the portion of the tooth that is beneath the gum tissue surface adjacent to the interdental papilla.

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In accordance with one aspect of the present invention an electro-mechanical dental flossing device employs a thin and flexible elongated member capable of being at least partly received between a tooth and the adjacent interdental papilla portion of the gum. The device employs a motive source to effect motion of the elongated member by way of a coupling.

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In accordance with another aspect of the invention, the elongated member manifests a predetermined cross-section. In accordance with various aspects of the invention the member may have: a generally circular cross-section with a diameter no greater than approximately 0.025 inch; a generally elliptical cross-section with a minor diameter no greater than approximately
35 0.025 inch; a cross-section generally circumscribed by a top, a bottom and inwardly concave

arcuate sides when the maximum transverse distance between corresponding points of the side is no greater than approximately 0.025 inch.

In accordance with another aspect of the invention, the motive source is a motor which includes a shaft with an eccentric member mounted thereon. The coupling has a translation member connected to the elongated member and an axial aperture which receives the eccentric member. Rotation of the eccentric member causes repetitive translation of the coupling and the elongated member. Alternatively, flossing motion of the elongated member is effected by connecting the base of the elongated member directly to the motor shaft or eccentric.

In accordance with another aspect of the invention, the elongated member includes a conduit. The conduit is in communication with a fluid reservoir and with an orifice in the surface of the elongated member. A pump is disposed to propel fluid from the reservoir through the conduit to the orifice.

In accordance with another aspect of the invention, oscillatory motion is imparted to a flossing element by a translation member and a pivot element. Pivot element is connected to a bearing which moves the flossing element. Alternatively, the bearing is connected to a single translation member for imparting motion to the flossing element.

BRIEF DESCRIPTION OF THE DRAWING

The preferred exemplary embodiment of the present invention will hereinafter be described in conjunction with the appended drawing, wherein like designations denote like elements, and:

Figure 1 is a perspective drawing of a first embodiment of a flossing device in accordance with this invention;

Figure 2A is an elevational view showing the elongated member of the device of Figure 1 flossing the area between two teeth;

Figure 2B is front perspective view showing the elongated member of the device of Figure 1 flossing the area between a portion of a tooth that is beneath the gum tissue surface and the gum tissue itself;

Figure 3 is a cross sectional view of the flossing device of Figure 1 taken along the line 3-3 of Figure 1;

5 Figure 3A is a partial cross sectional view of an alternative embodiment of a mechanism for effecting motion of the elongated element in a flossing device in accordance with the present invention;

10 Figure 4 is a cross sectional view of device of Figure 1 taken along the line 4-4 of Figure 3;

Figure 5 is a cross sectional view of the device of Figure 1 taken along the line 5-5 of Figure 3;

15 Figure 6 is a cross sectional view of an alternative embodiment of the flossing device of Figure 1 taken along line 3-3 of Figure 1 including a fluid reservoir and a pump;

Figure 7 is an expanded view of the tip of the device of Figure 6;

20 Figures 8A-C are cross sectional views of various embodiments of an elongated member taken along line 8-8 of Figure 7;

Figure 9 is a cross-sectional view of the device of Figure 6 taken along line 9-9 showing a preferred embodiment of a pump;

25 Figures 10A and 10B are cross-sectional views of an alternative embodiment of the device having a translational member and a pivoting element connected by a U-joint;

30 Figures 11A and 11B are top and elevational views, respectively, of the translation member of Figures 10A-B;

Figures 12A and 12B are end and elevational views, respectively, of the pivoting element of Figures 10A-B;

35 Figures 13A and 13B are top and elevational views, respectively, of the flossing element of Figures 10A-B;

Figure 14 is an elevational view of a single unit translation member;

Figure 15 is a cross-sectional view of a conical tip and spherical bearing; and

Figures 16A and 16B are end and cross-sectional views, respectively, of a conical tip and a spherical bearing having truncated sides.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Figures 1 and 3, an electro-mechanical dental flossing device 10 in accordance with the present invention suitably comprises a lower cap 12, a case 14, a generally conical tip 18, enclosing a power source 32 (e.g. battery), a motor 28, a switch 16, an elongated (flossing) member 22, and a mechanism coupling member 22 to motor 28. The coupling mechanism suitably includes a translation member 24 pivotally mounted within case 14. Lower cap 12 is removably fixed to one end of case 14. Electrical control switch 16 extends through the sidewall of case 14. Conical tip 18, suitably formed of a resilient material such as a polymer or rubber composition, is attached, preferably removably, to the opposite end of flossing device case 14. Elongated member 22 extends through a rubber insert 20, which is disposed within tip 18 as shown in Figure 3.

Elongated member 22 includes a base portion 21, an intermediate portion 23 and a tip portion 25. As will be more fully discussed, at least intermediate portion 23, and preferably also tip portion 25 are configured to be received between the teeth and the interdental papilla. Elongated member 22 can be made of any material suitable for use in the human mouth which is flexible and resilient. Suitable materials can include plastics, metal wire, textiles and the like which are flexible, have a memory and are impregnable to the environment of the mouth. For example, elongated member 22 may comprise a nickel-titanium alloy wire, having a diameter on the order of about 0.010 inches to about 0.025 inches. In some cases, a protective coating of plastic or other insulator, such as, but not limited to, TEFLON™ may also be employed.

If desired, elongated member 22, or protective coating, or both can be impregnated with a diffusant, such as a medicament, e.g. fluoride, a fluoride release, a germicide, or an anti-bacterial release, or a flavor, such as mint or cinnamon. As will hereafter be described, fluids such as, for example, medicaments and mouthwash, can also be applied to the user's teeth and gums through member 22A.

Referring to Figure 3, power source 32, which is preferably a battery, is electrically coupled to electric motor 28. Motor 28 is selectively energized by power source 32 through switch 16.

Motor 28 is employed to oscillate elongated member 22. Motor 28 includes an axially protruding arm 30 which rotates when motor 28 is energized. The distal end of axial arm 30 includes an eccentric 31 (e.g. cam) disposed to penetrate an axial aperture 33 on one end of motion translation member 24. Base 21 of elongated member 22 is secured to the opposite end of translation member 24. Preferably, base 21 is received in axial bore 27 in translation member 24. Base 21 is preferably removably engaged by friction fit, or otherwise secured in bore 27. Motion translation member 24 is free to oscillate about a pin 26 which is fixedly attached to an inner wall 35 of case 14.

Flossing device 10 provides a particularly convenient mechanism for effectively and efficiently accessing not only the tooth surfaces between the teeth for cleaning and application of fluids, but also the sulcus between the interdental papilla portions of the gum and the teeth, irrespective of contact areas between the teeth. Referring to Figures 2A and 2B, the human mouth includes a plurality of adjacent teeth 36 disposed in the gums 34. Each tooth typically includes a crown (body) portion projecting above the gum, a root connecting the tooth to bone, and a constricted neck portion between the root and crown surrounded by the gums. In many instances, the relative disposition of adjacent teeth 36 create contact areas 37 between the crowns of the teeth, i.e., portions of the crowns of adjacent teeth touch or nearly touch. In many such instances, contact areas make access to the sulcus between interdental papilla and the neck of the tooth from above, as conventionally required, particularly difficult, if not impossible. Tip 25 and intermediate portion 23 of elongated member 22 are dimensioned and configured to be received between teeth 36 (Figure 2A). Intermediate portion 23, and preferably tip 25, are also dimensioned and configured to be received in the sulcus between interdental papilla and tooth (Figure 2B). However, elongated member 22, while resilient, is sufficiently stiff to maintain its shape, and thus is capable of being inserted into the area between teeth 36 and ultimately within the sulcus, irrespective of contact areas 37 by passing between teeth 36 from the labial (front) or lingual (back) directions below the contact areas. A flossing action is realized through motion of member 22 with member 22 situated as shown in Figures 2A and 2B.

Referring to Figure 4, motion translation member 24 is fixedly attached to inner wall 35 of flossing device case 14 by pin 26. When flossing device 10 is in operation, motion translation member 24 oscillates about fixed pin 26 as shown by arrows 39 in Figure 3.

Referring to Figures 3 and 5, eccentric 31 on arm 30 is received within axial aperture 33 of motion translation member 24. When rotated, the periphery of eccentric 31 effectively moves about an axis that is off-set from the axial center of motion of translation member 24 such that the rotation of eccentric 31 produces an oscillatory motion of motion translation member 24 about pin 26. Thus, rotation of the axial arm 30 by electric motor 28 causes an oscillation motion (as shown by the arrows 39) of motion translation member 24.

In operation, electric switch 16 completes the electrical circuit to energize electric motor 28 from power supply 32. If desired, switch 16 can have multiple settings for different oscillation speeds of motor 28. While operating, electric motor 28 rotates axial arm 30. The rotation of eccentric 31 by axial arm 30 within axial aperture 33 of motion translation member 24 causes the oscillatory motion of the motion translation member 24 about fixed pin 26. Due to the rapid oscillation of motion translation member 24, elongated member 22 oscillates to produce the desired flossing action between two teeth 36 or between a tooth 36 and gum portion 34.

The desired flossing motion can be imparted to elongated member 22 in numerous ways in addition to the mechanism described above. For example, as shown Figure 3a, in an alternative embodiment, translation member 24 can be omitted and the base of member 22 can be directly connected to the distal end of motor arm 30, e.g. to eccentric 31. As a consequence of the arcuate disposition of elongated member 22 with respect to the axis of motor arm 30, and the interaction of member 22 with, e.g., conical tip 18, rotation of arm 30 will cause member 22 to effect movement with both rotational and translatory components, e.g., to effectively precess as generally indicated in dotted line in Figure 3a. The translatory component of such motion is of greater magnitude if the base of member 22 is attached to motor arm 30 offset from the central axis of arm 30, e.g., in the vicinity of the periphery of eccentric 31.

Referring now to Figure 6, an alternative embodiment of a flossing device 10a includes provisions for applying fluids such as medicaments to the gums and teeth. Flossing device 10a suitably includes, in addition to the components previously described in conjunction with Figures 1 through 5, a fluid reservoir 60, a pump 68, and respective conduits 66 and 70 providing communication between reservoir 60, pump 68, and ultimately elongated member 22. As will be discussed, in this embodiment, elongated member 22 includes an axial conduit and apertures for delivering the fluid to the user's teeth and gums. Fluid reservoir 60 is suitably a collapsible polymeric bag, having a capacity of from about two to four liquid ounces. If desired, reservoir 60 can be refillable communicating with capped filling orifice 64 extending through the sidewall

of casing 14. Alternatively, reservoir 60 can be disposable, removably received within casing 14 and releasably coupled to conduit 66. Fluid reservoir 60 may be any vessel capable of containing fluid and dispensing it through conduit 66. Reservoir 60 is preferably configured to be disposed within casing 14. However, if desired, conduit 66 can be channeled through the sidewall of casing 14 and cooperate with an external reservoir. In this case, reservoir 60 would be purchased prefilled with the medicament or other fluid to be applied to the user's teeth and gums, made to communicate with conduit 66 and received within casing 14. Communication with conduit 66 can be effected in any convenient manner, such as, for example, a nipple which is punctured and received within the end of conduit 66, a fixture on the end of conduit 66 which punctures a resilient portion of reservoir 60 or cooperating fittings, or the like, applying fluids such as medicaments, bactericides, germicides, fluorine treatments, mouthwash or the like to the user's teeth and gums.

If desired a level indicating mechanism can be provided. For example, reservoir 60 may be formed of a translucent or transparent material, and a window 62 provided in the side wall of casing 14.

Referring now to Figure 6 and 7, elongated member 22a includes an axial conduit 74 communicating between a first orifice 72 in base portion 21, and at least one small orifice disposed in either intermediate portion 23 or tip portion 25, as will be explained. Preferably, numerous small orifices are provided in intermediate portion 23, communicating through the sidewall of intermediate portion 23 from conduit 74.

Conduit 70 is coupled to elongated element conduit 74. The coupling may be effected by any mechanism consistent with the movement of element 22a effected by translation member 24. Preferably, as in the embodiment of Figures 1 through 5, base 21 of elongated member 22a is received in a friction fit in an axial bore 27 in translation member 24. Preferably, the communication is effected through translation member 24. A transverse channel 75 is formed extending from axial bore 27 through the sidewall of member 24, and is configured to closely receive and retain the end of conduit 70. Conduit 70 is preferably formed of resilient material and enough slack is provided to permit the desired movement of member 24 and elongated element 22a.

In operation, pump 68 draws a fluid from reservoir 60 causing it to flow through conduits 66, 70, and 74, so that it is ultimately dispensed through orifices 76 and elongated member 22a.

Pump 68 may be any device suitable for effecting that function, preferably driven by motor 28. Referring to Figures 6 and 9, a particularly advantageous pump 68 employs a cam or eccentric 90 disposed for rotation on arm 30. A flexible conduit 92, coupling conduits 66 and 70 is disposed for cooperation with the periphery of eccentric 90. A retainer 94, suitably in the form of an annulus, may be employed to ensure proper disposition of conduit 92 relative to eccentric 90. Eccentric member 90 is suitably elliptical in shape. When rotated, the periphery of eccentric 90 in the vicinity of the long axis, partially collapses or otherwise distorts conduit 92, drawing fluid from reservoir 60 and urging the fluid in conduit 92 into conduit 70, and ultimately to orifices 76. If desired, conduits 66, 92, and 70, can be formed of a single length of resilient, e.g., polymeric tubing.

If desired, particularly where replaceable elongated members 22, 22a are employed, conical tip 18 may be removably connected to casing 14 to facilitate replacement of elongated member 22, 22a. The connection is preferably water tight. Referring to Figure 7, respective collars 80 and 82, are formed on the upper periphery of casing 14, and lower inner periphery of tip 18, respectively. The inside diameter of the base of tip 18 is slightly larger than that of collar 80. Collars 80 and 82 are resilient enough that collar 82 will snap over collar 80. In addition, a flexible O-ring 83 can be employed if desired.

Intermediate portion 23, and preferably tip 25, may manifest any cross section in accordance with the present invention so long as it may be received between the inter-dental papilla portion of the gums and an adjacent tooth. The cross section can be consistent along its length, or may vary with length. In the simplest case, as shown in Figure 8A, a circular cross section can be employed. The diameter of the cross section is sufficiently small to be received between inter-dental papilla and tooth, e.g., no greater than about 0.025-inch. Similarly, as shown in Figure 8B, all or a part of intermediate portion 23 may manifest an elliptical cross section having a minor diameter that is sufficiently small so that it can be received between inter-dental papilla and adjacent tooth, e.g., no greater than 0.025-inch. In each instance, axial conduit 74, and orifices 76 communicating with axial bore 74 are preferably provided.

However, more complex cross sections can be advantageously employed. For example, referring to Figure 8C, one embodiment of intermediate portion 23 of elongated member 22a in accordance with the present invention has a cross-section circumscribed by a top 84, a bottom 86 and respective sides 88. Sides 88 are suitably arcuate, namely, inwardly directed concave arcs. Orifices 76 are situated in the narrow waist of sides 88. In accordance with the preferred

embodiment, the maximum transverse distance between corresponding points on sides 88 is sufficiently small so intermediate portion 23 can be accommodated between the interdental papilla portion of the gum and the surface of the adjacent tooth, e.g., is no greater than about 0.025 inch. Bottom 86 also suitably converges to a point 87.

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The mechanism coupling flossing (elongated) member 22 to motor 28 can take any form suitable for imparting the desired motion to member 22. For example, translation member 24 can be formed of multiple articulated parts. Alternatively, it can be formed of a single piece, extending into conical tip 18, and there receiving flossing member 22. For example, referring to Figures 10A-B, 11A-B, and 12A-B, such an alternative embodiment of the present flossing device suitably includes a pivot element 1002 connected between a translation member 24a and a flossing element 1004 (similar to flossing member 22).

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As in the embodiments of Figures 3 and 6, translation member 24a (Figures 11A-B), is comprised of substantially rigid material, suitably includes axial aperture 33; and is pivotally mounted within case 14, e.g. by pin 26. Axial aperture 33 receives eccentric 31 to translate the rotational movement of motor arm 30 and eccentric 31 into pivotal motion of translation member 24a. In this embodiment, pin 26 is formed integrally with translation member 24a and rotatably mounted within case 14. The distal end of translation member 24a, bears part of a mechanism for pivotably connecting translation member 24a to pivot element 1002, e.g. a receiving portion of a U-joint 1006: an axial slot 1102 (Figure 11A); and a pair of lateral recesses (slots) 1104 on either side of slot 1102 (Figure 11B).

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As previously noted, pivot element 1002 (Figures 12A-B) couples flossing element 1004 to translation member 24a. Pivot element 1002 suitably comprises a length of substantially flat, rigid material with one end adapted for articulating with translation member 24a, and the other end adapted to receive, and impart motion to flossing element 1004, while at the same time sealing the interior of the unit. More specifically, pivot element 1002 includes respective pins 1202 and 1204 extending perpendicularly from its sides proximate to one end, and a bearing 1208 at the other end.

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Pins 1202 and 1204 cooperate with the receiving portion at the distal end of translation member 24a, to permit translation member 24a to impart motion to pivot element 1002; Translation member 24a and pivot element 1002 are suitably connected by U-joint 1006 (Figures 10A-B), formed by the cooperation of pivot element pins 1202 and 1204 (Figure 12A-B) with

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axial slot 1102 (Figure 11A) and lateral recesses 1104 (Figure 11B). In assembly, the end of pivot element 1002 is received in axial slot 1102, with pins 1202 and 1204 slidably received in recesses 1104, such that pivot element 1002 can rotate (pivot) with respect to translation member 24a about an axis 1206 defined by pins 1202, and 1204. Recesses 1104 are suitably deep enough to accommodate axial movement of pins 1202 and 1204 as the relative longitudinal positions of translation member 24a and pivot element 1002 change.

Bearing 1208 receives the base of flossing element 1004, and is itself received within a conforming socket in tip 1010, to provide an essentially water tight seal while at the same time imparting motion to flossing element 1004. For example, a bearing 1208 (Figure 12B), configured as a laterally disposed cylinder, may be integrally formed in the end of pivot element 1002. Bearing 1208 is received within a conforming socket within a tip 1010 attached to case 14. Bearing 1208 fits snugly within the socket, but is permitted to rotate within tip 1010 as pivot element 1002 is moved by translation member 24a.

The exterior of tip 1010 is suitably conforms in shape to the exterior of case 14, and includes an aperture 1012 through which flossing element 1004 is disposed. Aperture 1012 is suitably of appropriate width or diameter to permit flossing element 1004 to oscillate through the entire angle through which bearing 1208 and pivot element 1002 rotate.

Flossing element 1004 is suitably rigidly and removably connected to pivot element 1002 so that movement of pivot element 1002 is translated into motion of flossing element 1004. For example, a cavity 1210 of predetermined configuration, e.g. wedge-shaped, formed in bearing 1208, in general alignment with aperture 1012, for receiving flossing element 1004 as described below. Cavity 1210 suitably includes a pair of undercuts 1212A, 1212B protruding from the sides of cavity 1210 near the perimeter of bearing 1208.

Referring now to Figures 13A-B, flossing element 1004 suitably includes: a base portion 21a comprising a barb 1302, and, if desired, a pair of protrusions 1304A-B; an intermediate portion 23; and a tip portion 25. As in the previously described embodiments, at least intermediate portion 23, and preferably also tip portion 25 are configured to be received between the teeth and the interdental papilla. Intermediate portion 23 and tip 25 are of a length suitable for penetrating between teeth, and are suitably curved to provide optimal flossing angle.

Barb 1302 is suitably integrally formed of resilient material in the end of flossing element 1004, and configured to snugly mate with cavity 1210 formed in the end of pivot element 1002.

As barb 1302 is inserted into cavity 1210, the outer edges of barb 1210 are compressed by undercuts 1212A-B until barb 1302 is completely inserted into cavity 1210. When barb 1302 is fully inserted, the outer edges of barb 1302 resume their original shape, thus securing barb 1302 in place within cavity 1210 behind undercuts 1212A-B. Further, barb 1302 may be slightly larger than cavity 1210, and when engaged, may expand bearing 1208 within the socket in tip 1010, making the unit substantially water tight, while still permitting movement of flossing element 1004.

To remove flossing element 1004 from pivot element 1002, flossing element 1004 may be simply pulled away from pivot element 1002, causing the resilient outer edges of barb 1302 to compress and release flossing element 1004. To facilitate removal of flossing element 1004, protrusions 1304A-B may be formed in the outer surface of flossing element 1004 to provide a surface upon which a removal force may be exerted. For example, protrusions 1304A-B may be engaged by a tool, and located a suitable distance from the end of tip 1010 to permit the removing tool to slide between conical tip 1010 and protrusions 1304A-B. By pulling upon protrusions, flossing element 1004 may be pulled away from pivot member, thus removing flossing element 1004 from pivot member.

In another alternative embodiment, translation member 24a and pivoting element 1002 may be replaced with a suitable singular pivoting translation member. Referring to Figures 14 and 15, such a translation member 1400 suitably includes a tapered, elongated body generally conforming to the configuration of the surrounding portion of casing 14, an axial aperture 33 at the proximate end, and bearing 1008 at the distal end. Axial aperture receives eccentric 31 for translating rotational movement of eccentric 90 into transverse motion of translation member 1400. Bearing 1008 serves the functions previously noted, and, additionally serves as the pivot point for translation member 1400. Bearing 1008 may be integrally formed in the end of translation member 1400 and disposed within a conforming socket in tip 1010.

Bearing 1008 is suitably substantially cylindrical or, alternatively, may be substantially spherical. Referring to Figure 15 a spherical bearing 1500 suitably has a cavity 1502 of predetermined configuration for receiving and engaging a like configured flossing element base formed. For example cavity 1502 may be conical, and mates with a conical barb formed on the base of flossing element 1004 (not shown). Conical cavity may further include an annular undercut 1504 for retaining the conical barb of flossing element 1004.

If desired, bearing 1500 may have truncated sides 1610A-B, as shown in Figure 16, to facilitate the alignment of bearing 1500 within tip 1010. Bearing 1500 may also include a pair of pins 1604A-B. Pins 1604A-B may be disposed within recesses formed in tip 1010 to facilitate alignment and restrict motion of bearing 1500 within tip 1010 to within a particular plane.

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Although the invention has been particularly shown and described with reference to the preferred embodiment thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

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CLAIMS

WE CLAIM:

- 5 1. Apparatus for cleaning the surfaces of teeth underlying the interdental papilla portion of the gums in a human mouth, comprising:
- a flexible, resilient elongated member;
- 10 said elongated member including a base portion, an elongated intermediate portion of predetermined cross-sectional configuration, and a tip;
- said intermediate portion and said tip being capable of being received between adjacent teeth without traversing any contact areas between the teeth from at least the front of
- 15 the mouth; and
- at least the intermediate portion being capable of being received in the sulcus between a tooth and the adjacent interdental papilla portion of the gum; and
- 20 a motive source; and
- a coupling connecting the base portion of the elongated member to the motive source to effect motion of the elongated member.
- 25 2. The apparatus of claim 1, wherein both said intermediate portion and said tip are capable of being received in the sulcus between a tooth and the adjacent interdental papilla portion of the gum.
- 30 3. The apparatus of claim 1 wherein said coupling effects oscillation of the elongated member.
4. The apparatus of claim 1, wherein said intermediate portion has a generally circular cross-section and a diameter no greater than approximately 0.025 inch.
- 35 5. The apparatus of claim 1, wherein said intermediate portion has a generally elliptical cross-section with a minor diameter no greater than approximately 0.025 inch.

6. The apparatus of claim 1, wherein said motive source comprises a motor.

7. The apparatus of claim 6, wherein said motive source comprises a battery driven motor.

5 8. The apparatus of claim 1, wherein said coupling connecting the elongated member to the motive source comprises means for effecting a motion of the elongated member having a rotational component.

10 9. The apparatus of claim 1, wherein said coupling connecting the elongated member to the motive source comprises an eccentric.

10. The apparatus of claim 6, wherein:

15 said motor includes a shaft with an eccentric member mounted thereon; and

coupling comprises a translation member connected at a first end to said elongated member, and an aperture in the vicinity of the opposing end;

20 the translation member being pivotally mounted and disposed to receive the eccentric member in said aperture, such that rotation of said eccentric member causes repetitive translation of said first end to effect oscillation of said elongated member.

11. The apparatus of claim 10, wherein said translation member first end includes means for releasably receiving the base portion of said elongated member.

25 12. The apparatus of claim 11, wherein said means for releasably receiving the base portion of said elongated member comprises an aperture configured to receive said elongated member base portion.

30 13. The apparatus of claim 10, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and at least said sides are arcuate.

14. The apparatus of claim 12, wherein said intermediate portion has a generally circular cross-section.

15. The apparatus of claim 12, wherein said intermediate portion has a generally elliptical cross-section.

16. The apparatus of claim 13, wherein said arcuate sides are each inwardly directed concave.

17. The apparatus of claim 16, wherein said intermediate portion cross-section has a maximum transverse distance between corresponding points on said sides is no greater than approximately 0.025 inch.

18. The apparatus of claim 13, wherein said bottom converges to a point.

19. The apparatus of claim 1 wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and wherein said bottom converges to a point.

20. The apparatus of claim 1, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a diffusant.

21. The apparatus of claim 1, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a medicament.

22. The apparatus of claim 21, wherein said medicament is chosen from the group consisting of fluoride, fluoride releases, germicides, and anti-bacterial releases.

23. The apparatus of claim 1, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a flavor.

24. The apparatus of claim 1, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and with a maximum transverse distance between said sides is no greater than approximately 0.025 inch.

25. The apparatus of claim 1, wherein said coupling is detachably connected to said elongated member.

26. The apparatus of claim 25, wherein said coupling includes an aperture configured to receive said elongated member base portion.

27. The apparatus of claim 1, wherein said elongated member includes a conduit, and said apparatus further includes:

a fluid reservoir communicating with said elongated member conduit; and

5 a pump disposed to propel fluid from said reservoir through said conduit.

28. The apparatus of claim 27 wherein said coupling is detachably connected to said elongated member.

10 29. The apparatus of claim 27, wherein said fluid reservoir is removably coupled to said elongated member conduit.

30. The apparatus of claim 27, wherein said motive source, coupling, pump and reservoir are contained within a common casing.

15 31. The apparatus of claim 27, wherein said conduit comprises an axial passage through said elongated member communicating with at least one orifice in the surface of said elongated member.

20 32. The apparatus of claim 27, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and said conduit comprises an axial passage through said elongated member communicating with at least one orifice in a side of said elongated member.

25 33. The apparatus of claim 27, wherein said coupling includes a passage which receives said elongated member and communicates with said elongated member conduit and said reservoir.

34. The apparatus of claim 27, wherein said coupling passage is configured to releasably receive said elongated member base.

30 35. The apparatus of claim 27, wherein said pump comprises an eccentric element driven by said motive source.

35 36. The apparatus of claim 27, wherein said motive source, coupling, pump and reservoir are contained within a common casing.

37. The apparatus of claim 36, wherein said reservoir communicates with said elongated member conduit through an elastic tube, and said eccentric element is disposed to cooperate with said tube to create a flow of fluid therethrough.

5 38. Apparatus for interacting with the surfaces of teeth underlying the interdental papilla portion of the gums in a human mouth, comprising:

a housing;

10 a flexible, resilient elongated member, extending outwardly from one end of said housing;

said elongated member including a base portion, an elongated intermediate portion of predetermined cross-sectional configuration, and a tip;

15

said intermediate portion and said tip being capable of being received between adjacent teeth from at least the front of the mouth; and

20

at least the intermediate portion being capable of being received in the sulcus between a tooth and the adjacent interdental papilla portion of the gum;

a motor disposed within said housing; and

25

a coupling connecting the elongated member to the motor to effect motion of the elongated member.

39. The apparatus of claim 38, wherein said coupling effects oscillation of the elongated member.

30

40. The apparatus of claim 38, wherein:

said motor includes a shaft with at least a first eccentric member mounted thereon; and

35

coupling comprises a translation member connected at a first end to said elongated

member, and an axial aperture on the opposing end;

the translation member being pivotally mounted in said housing and disposed to receive the eccentric member in said aperture, such that rotation of said eccentric member causes repetitive translation of said first end to effect oscillation of said elongated member.

41. The apparatus of claim 40, wherein said translation member first end includes means for releasably receiving the base portion of said elongated member.

42. The apparatus of claim 40, wherein said translation member first end includes an axial bore

43. The apparatus of claim 40, wherein said elongated member includes a conduit communicating with at least one orifice in the surface of said elongated member, and said apparatus further includes:

a fluid reservoir communicating with said elongated member conduit; and

a pump disposed to propel fluid from said reservoir through said conduit.

44. The apparatus of claim 43, wherein said conduit comprises an axial passage through said elongated member.

45. The apparatus of claim 43, wherein said fluid reservoir is releasably coupled to said pump.

46. The apparatus of claim 43, wherein said fluid reservoir is disposed within said housing.

47. The apparatus of claim 46, wherein said fluid reservoir comprises a disposable container prefilled with fluid.

48. The apparatus of claim 43, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and said conduit comprises an axial passage through said elongated member communicating with at least one orifice in the surface of said elongated member.

49. The apparatus of claim 43, wherein said coupling includes a passage which receives said elongated member.

50. The apparatus of claim 49, wherein said coupling passage communicates with both said
5 elongated member conduit and said reservoir.

51. The apparatus of claim 49, wherein said coupling passage releasably receives said elongated member base.

10 52. The apparatus of claim 43, wherein said pump comprises a second eccentric element driven by said motor.

53. The apparatus of claim 52, wherein said reservoir communicates with said elongated member conduit through an elastic tube and said eccentric element is disposed to cooperate with said tube
15 to create a flow of fluid therethrough.

54. The apparatus of claim 38, wherein said elongated member includes a conduit communicating with at least one orifice in the surface of said elongated member, and said apparatus further includes:

20

a fluid reservoir communicating with said elongated member conduit; and

a pump disposed to propel fluid from said reservoir through said conduit.

25 55. The apparatus of claim 54, wherein:

said reservoir communicates with said elongated member conduit through an elastic tube;
and

30 said pump comprises an eccentric element driven by said motor, disposed to cooperate with said tube to create a flow of fluid therethrough.

56. The apparatus of claim 6, wherein the motor includes a shaft with an eccentric member
35 mounted thereon; and the coupling comprises:

a translation member with an aperture in the vicinity of the proximal end disposed to receive the eccentric member,

5 a pivot member, with a proximal end coupled to the distal end of the translation member and a distal end pivotally mounted and adapted to receive the elongated member base portion,

10 rotation of the eccentric member in the translation member aperture causing repetitive translation of the translation member distal end to effect oscillation of the pivot member and the elongated member.

57. The apparatus of claim 56, wherein said translation member first end includes means for releasably receiving the base portion of said elongated member.

15 58. The apparatus of claim 57, wherein said means for releasably receiving the base portion of said elongated member comprises an aperture configured to receive said elongated member base portion.

20 59. The apparatus of claim 10, wherein said translation member is pivotally mounted at the first end and the first end includes means for releasably receiving the base portion of said elongated member.

60. The apparatus of claim 38, wherein:

25 the housing includes a tip portion;

the tip portion includes an internal chamber of predetermined configuration, and first and second apertures communicating with the chamber,

30 the coupling connecting the elongated member to the motor comprises a connecting member,

the connecting member is operatively connected to the motor, and includes a bearing at one end;

35 the bearing conforms in configuration to the housing tip portion chamber and includes an

aperture for receiving the base portion of the elongated member;

the connecting member extends through the housing tip second aperture with the bearing seated in the chamber, and

5

the bearing aperture is aligned with the housing tip first aperture, such that the elongated member extends through the housing tip first aperture with the base portion received in the bearing aperture.

10

61. The apparatus of claim 60 wherein the bearing is generally spherical.

62. The apparatus of claim 60 wherein the bearing comprises a portion of a sphere with flattened sides.

15

63. The apparatus of claim 60 wherein the bearing comprises a cylinder disposed transversely to the longitudinal axis of the connecting member.

64. The apparatus of claim 63 wherein the bearing aperture is disposed in a sidewall of the cylinder.

20

65. The apparatus of claim 38, wherein:

the housing includes a tip portion;

25

the tip portion includes an internal chamber of predetermined configuration, and first and second apertures communicating with the chamber;

30

the coupling connecting the elongated member to the motor comprises a pivot member and a translation member;

the translation member is operatively connected to the motor, and to the pivot member, and is pivotally connected to the housing;

35

the pivot member includes a bearing at one end;

the bearing conforms in configuration to the housing tip portion chamber and includes an aperture for receiving the base portion of the elongated member,

5

the pivot member extends through the housing tip second aperture with the bearing seated in the chamber, and

10

the bearing aperture is aligned with the housing tip first aperture, such that the elongated member extends through the housing tip first aperture with the base portion received in the bearing aperture.

66. The apparatus of claim 65 wherein the translation member is operatively connected to the motor at one end and bears at least part of a mechanism for effecting a pivotal connection to the pivot element at the other end.

15

67. The apparatus of claim 65 wherein:

the translation member is operatively connected to the motor at one end and includes an axial slot and a pair of lateral recesses on either side of the axial slot;

20

the pivot member includes respective pins extending perpendicularly from its sides proximate to a second end;

25

the end of the pivot element is received in the translation member axial slot with the pivot member pins slidably received in the translation member recesses.

68. The apparatus of claim 65 wherein the bearing is generally spherical.

30

69. The apparatus of claim 65 wherein the bearing comprises a portion of a sphere with flattened sides.

70. The apparatus of claim 65 wherein the bearing comprises a cylinder disposed transversely to the longitudinal axis of the pivot member.

35

71. The apparatus of claim 70 wherein the bearing aperture is disposed in a sidewall of the cylinder.

AMENDED CLAIMS

[received by the International Bureau on 03 November 1994 (03.11.94);
original claims 17, 24, 42 and 53 amended; new claims 72-91 added;
remaining claims unchanged (6 pages)]

15. The apparatus of claim 12, wherein said intermediate portion has a generally elliptical cross-section.
- 5 16. The apparatus of claim 13, wherein said arcuate sides are each inwardly directed concave.
17. The apparatus of claim 16, wherein said intermediate portion cross-section has a maximum transverse distance between corresponding points on said sides no greater than approximately 0.025 inch.
- 10 18. The apparatus of claim 13, wherein said bottom converges to a point.
19. The apparatus of claim 1 wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and wherein said bottom converges to a point.
- 15 20. The apparatus of claim 1, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a diffusant.
21. The apparatus of claim 1, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a medicament.
- 20 22. The apparatus of claim 21, wherein said medicament is chosen from the group consisting of fluoride, fluoride releases, germicides, and anti-bacterial releases.
23. The apparatus of claim 1, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a flavor.
- 25 24. The apparatus of claim 1, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, with a maximum transverse distance between said sides no greater than approximately 0.025 inch.
- 30 25. The apparatus of claim 1, wherein said coupling is detachably connected to said elongated member.
26. The apparatus of claim 25, wherein said coupling includes an aperture configured to receive said elongated member base portion.
- 35

member, and an axial aperture on the opposing end;

the translation member being pivotally mounted in said housing and disposed to receive the eccentric member in said aperture, such that rotation of said eccentric member causes repetitive translation of said first end to effect oscillation of said elongated member.

41. The apparatus of claim 40, wherein said translation member first end includes means for releasably receiving the base portion of said elongated member.

42. The apparatus of claim 40, wherein said translation member first end includes an axial bore configured to receive said elongated member base portion.

43. The apparatus of claim 40, wherein said elongated member includes a conduit communicating with at least one orifice in the surface of said elongated member, and said apparatus further includes:

a fluid reservoir communicating with said elongated member conduit; and

a pump disposed to propel fluid from said reservoir through said conduit.

44. The apparatus of claim 43, wherein said conduit comprises an axial passage through said elongated member.

45. The apparatus of claim 43, wherein said fluid reservoir is releasably coupled to said pump.

46. The apparatus of claim 43, wherein said fluid reservoir is disposed within said housing.

47. The apparatus of claim 46, wherein said fluid reservoir comprises a disposable container prefilled with fluid.

48. The apparatus of claim 43, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and said conduit comprises an axial passage through said elongated member communicating with at least one orifice in the surface of said elongated member.

49. The apparatus of claim 43, wherein said coupling includes a passage which receives said elongated member.

50. The apparatus of claim 49, wherein said coupling passage communicates with both said
5 elongated member conduit and said reservoir.

51. The apparatus of claim 49, wherein said coupling passage releasably receives said elongated member base.

10 52. The apparatus of claim 43, wherein said pump comprises a second eccentric element driven by said motor.

53. The apparatus of claim 52, wherein said reservoir communicates with said elongated member conduit through an elastic tube and said second eccentric element is disposed to cooperate with
15 said tube to create a flow of fluid therethrough.

54. The apparatus of claim 38, wherein said elongated member includes a conduit communicating with at least one orifice in the surface of said elongated member, and said apparatus further includes:

20 a fluid reservoir communicating with said elongated member conduit; and
a pump disposed to propel fluid from said reservoir through said conduit.

25 55. The apparatus of claim 54, wherein:

said reservoir communicates with said elongated member conduit through an elastic tube;
and

30 said pump comprises an eccentric element driven by said motor, disposed to cooperate with said tube to create a flow of fluid therethrough.

56. The apparatus of claim 6, wherein the motor includes a shaft with an eccentric member
35 mounted thereon; and the coupling comprises:

71. The apparatus of claim 70 wherein the bearing aperture is disposed in a sidewall of the cylinder.

5 72. Apparatus for cleaning the surfaces of teeth underlying the interdental papilla portion of the gums in a human mouth, comprising:

a flexible, resilient elongated member,

10 said elongated member including a base portion, an elongated intermediate portion of predetermined cross-sectional configuration, and a tip;

15 said intermediate portion and said tip being capable of being received between adjacent teeth without traversing any contact areas between the teeth from at least the front of the mouth; and

at least the intermediate portion being capable of being received in the sulcus between a tooth and the adjacent interdental papilla portion of the gum;

20 a handle, and

a coupling releasably connecting the base portion of the elongated member to the handle.

25 73. The apparatus of claim 72, wherein both said intermediate portion and said tip are capable of being received in the sulcus between a tooth and the adjacent interdental papilla portion of the gum.

74. The apparatus of claim 72, wherein said intermediate portion has a generally circular cross-section and a diameter no greater than approximately 0.025 inch.

30 75. The apparatus of claim 72, wherein said intermediate portion has a generally elliptical cross-section with a minor diameter no greater than approximately 0.025 inch.

76. The apparatus of claim 72, wherein said coupling comprises an aperture configured to receive said elongated member base portion.

35

77. The apparatus of claim 72, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and at least said sides are arcuate.

5 78. The apparatus of claim 76, wherein said intermediate portion has a generally circular cross-section.

79. The apparatus of claim 76, wherein said intermediate portion has a generally elliptical cross-section.

10 80. The apparatus of claim 77, wherein said arcuate sides are each inwardly directed concave.

81. The apparatus of claim 80, wherein the maximum transverse distance between corresponding points on said sides is no greater than approximately 0.025 inch.

15 82. The apparatus of claim 77, wherein said bottom converges to a point.

83. The apparatus of claim 72, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and wherein said bottom converges to a point.

20 84. The apparatus of claim 72, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a diffusant.

25 85. The apparatus of claim 72, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a medicament.

86. The apparatus of claim 85, wherein said medicament is chosen from the class consisting of fluoride, fluoride releases, germicides, and anti-bacterial releases.

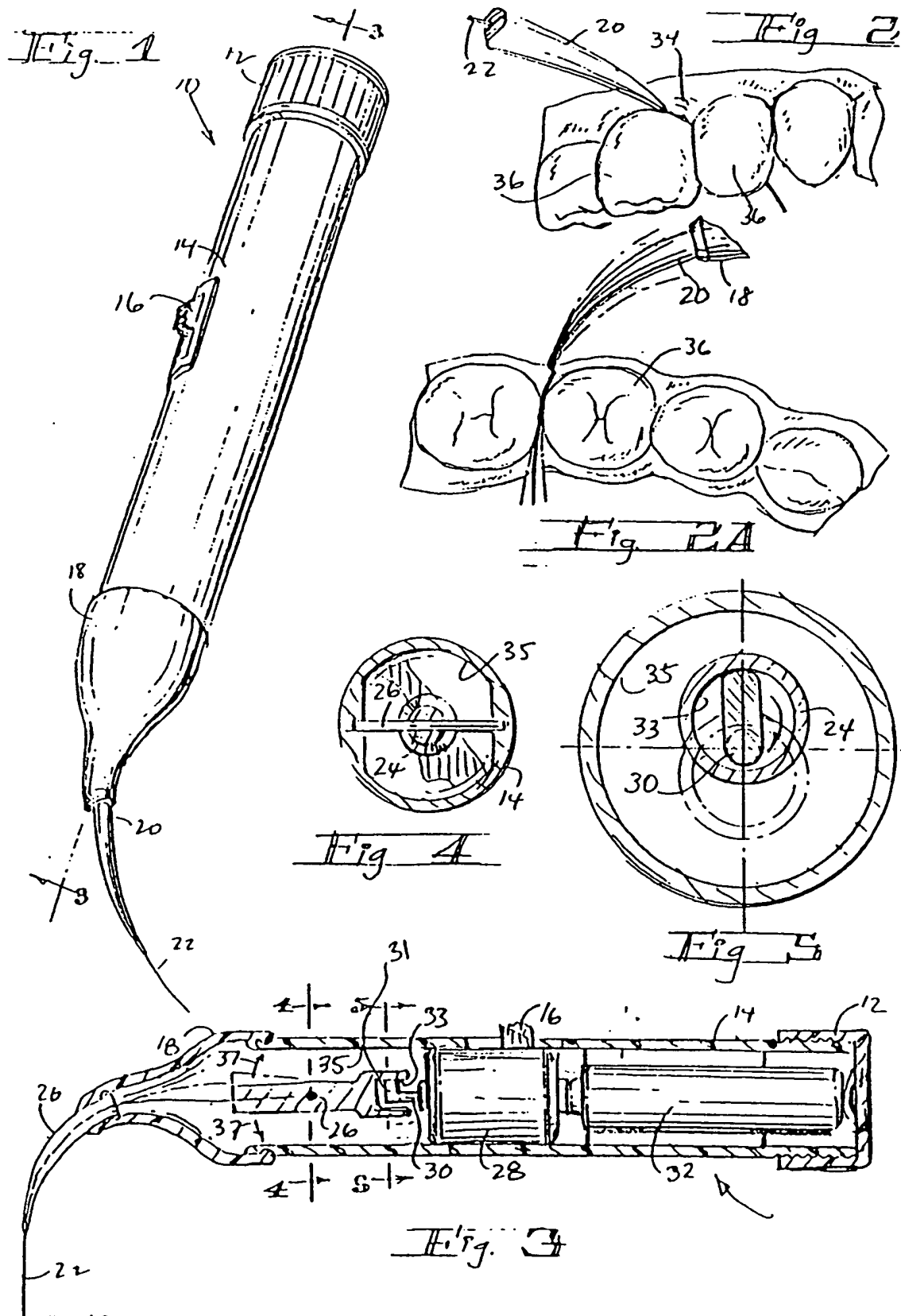
30 87. The apparatus of claim 72, wherein at least a portion of one of said intermediate portion and said tip are impregnated with a flavor.

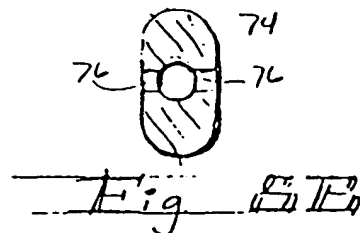
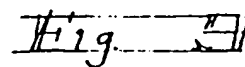
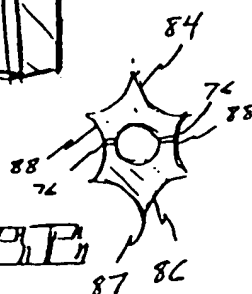
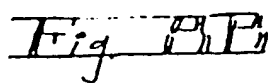
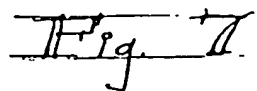
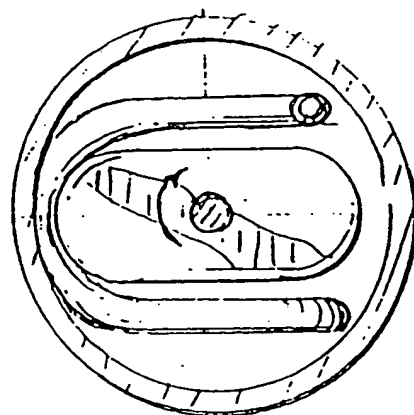
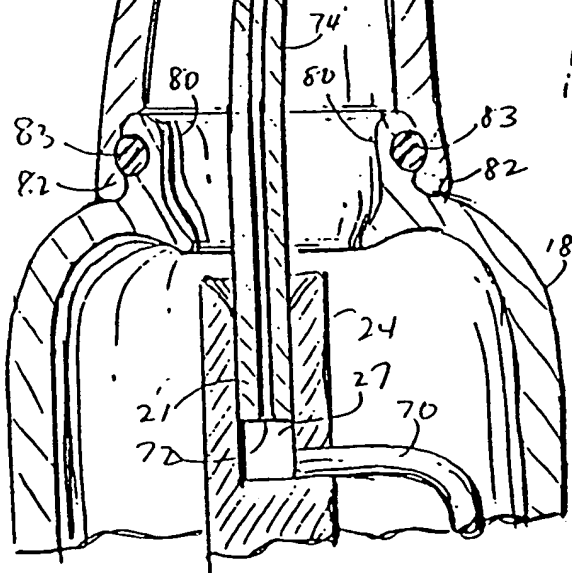
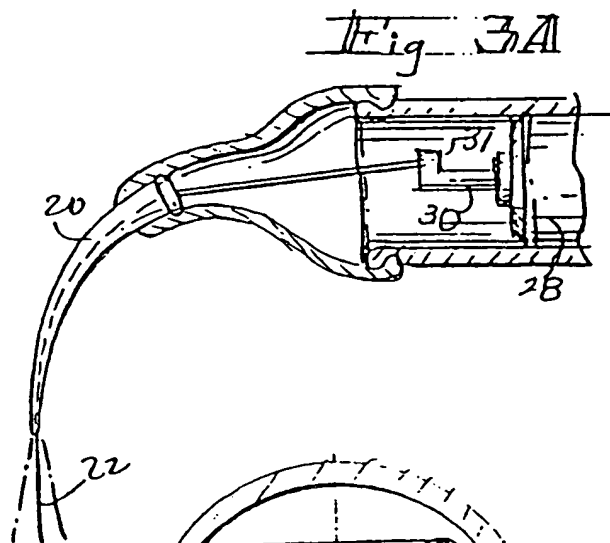
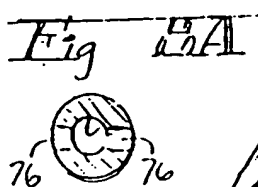
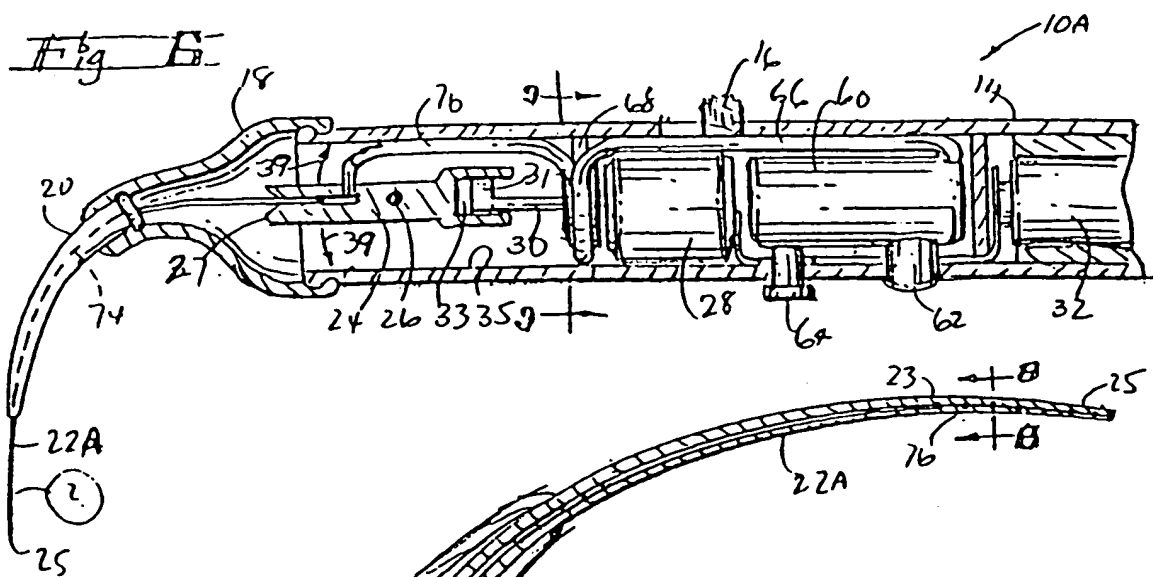
35 88. The apparatus of claim 72, wherein said intermediate portion has a cross-section circumscribed by a top, a bottom, and respective sides, and wherein the maximum transverse distance between said sides is no greater than approximately 0.025 inch.

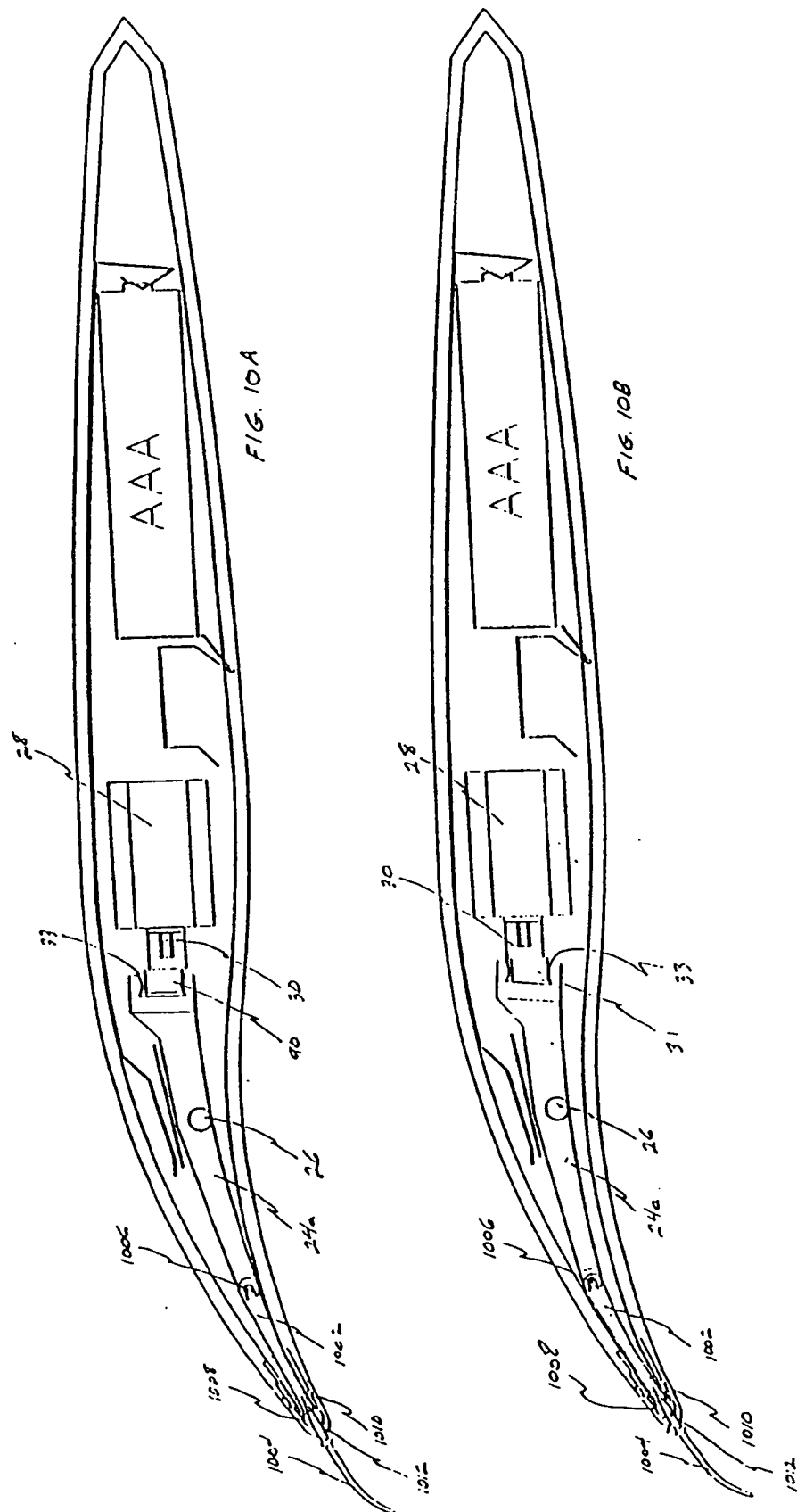
89. The apparatus of claim 72, wherein said coupling is detachably connected to said elongated member.

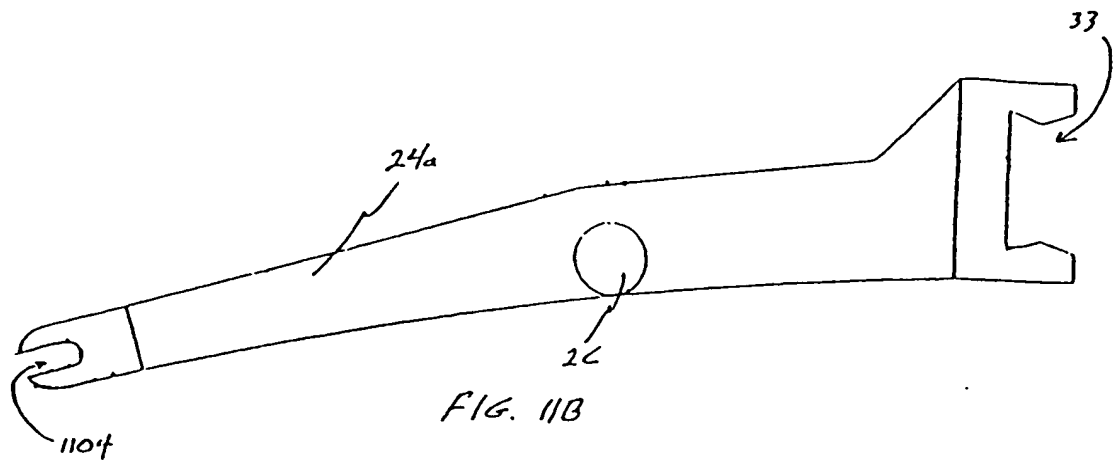
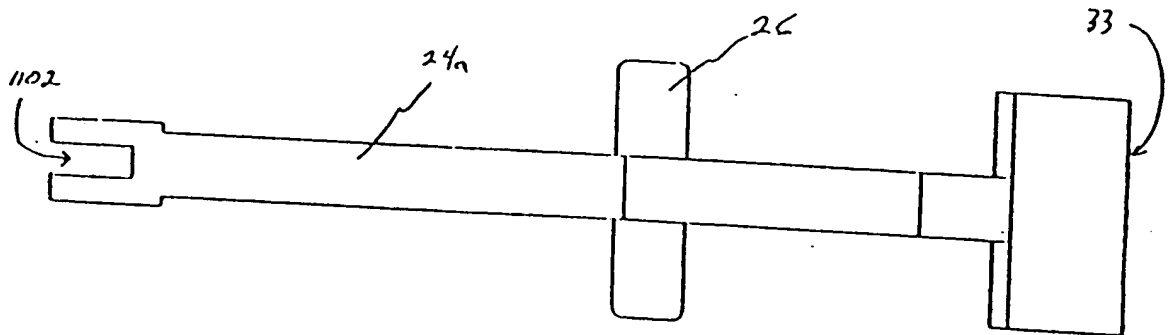
5 90. The apparatus of claim 89, wherein said coupling includes an aperture configured to receive said elongated member base portion.

10 91. The apparatus of claim 72, further comprising a motive source disposed within said handle; said coupling connecting the base portion of the elongated member to the motive source to effect motion of the elongated member.









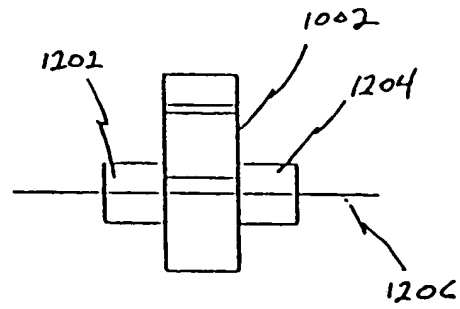


FIG. 12A

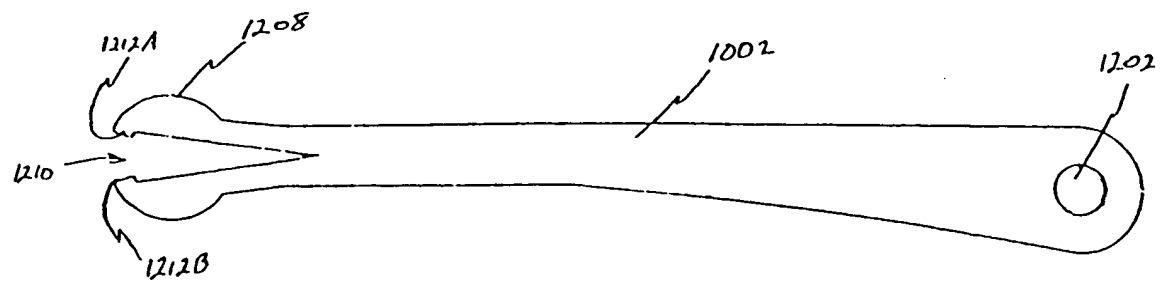


FIG. 12B

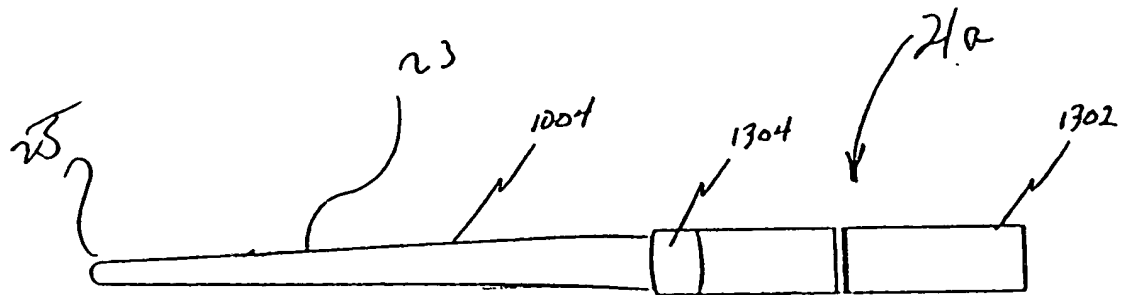


FIG. 13A

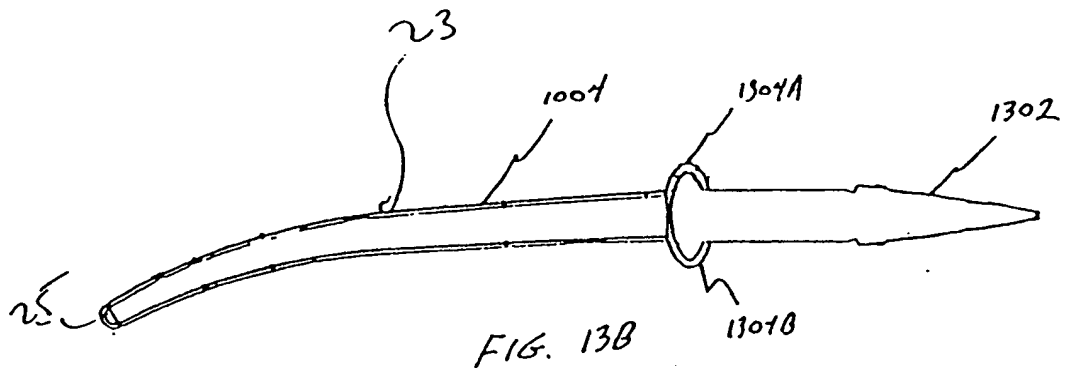
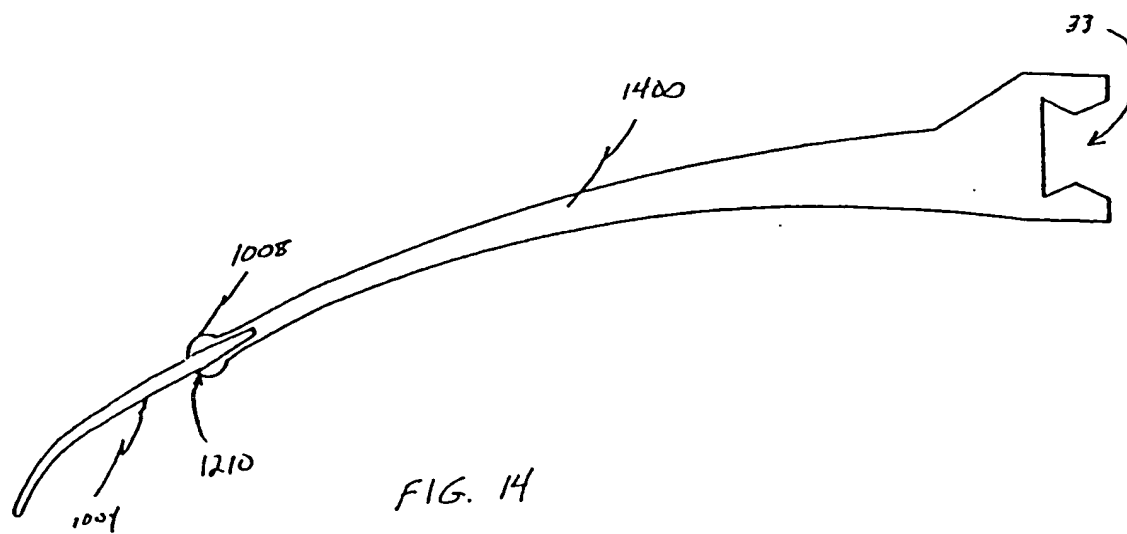


FIG. 13B



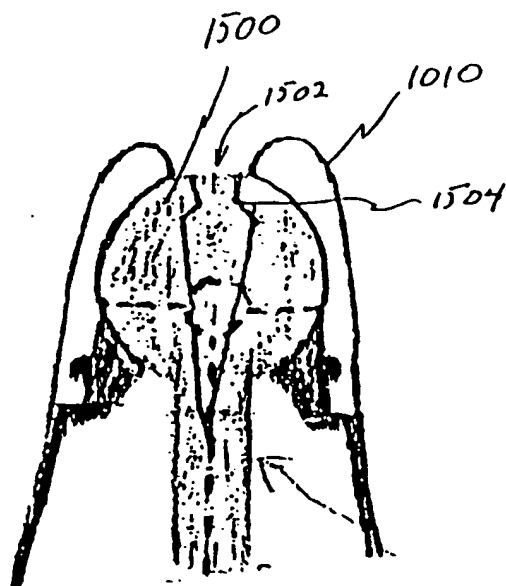


FIG. 15

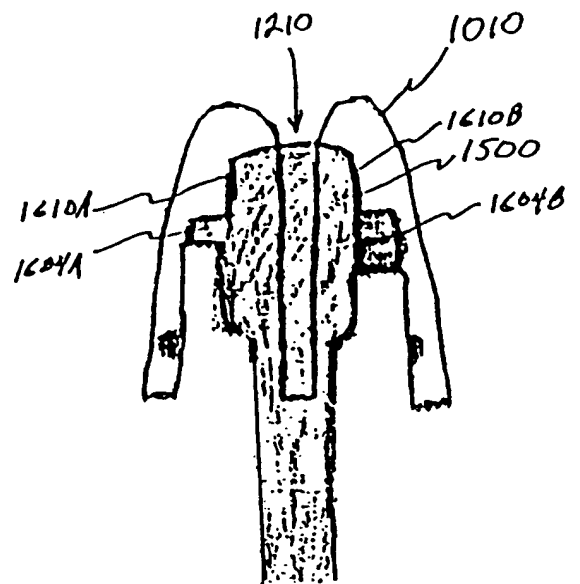


FIG. 16B

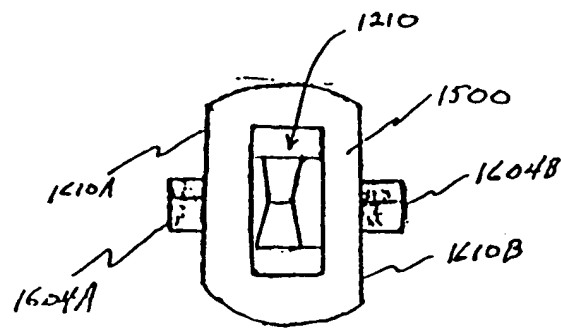


FIG. 16A

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61C15/04 A61C17/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 235 253 (MOORE) 25 November 1980 cited in the application see the whole document ---	1,38
A	US,A,5 224 500 (STELLA) 6 July 1993 see figures 1,2 ---	1,38
A	EP,A,0 354 352 (GEORG KARL GEKA-BRUSH) 14 February 1990 ---	
A,P	DE,A,42 26 659 (BRAUN) 17 February 1994 see the whole document -----	1,38

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

21 September 1994

Date of mailing of the international search report

11.10.94

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Raybould, B

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4235253	25-11-80	NONE	
US-A-5224500	06-07-93	NONE	
EP-A-0354352	14-02-90	DE-U- 8809217 JP-A- 2068051	01-09-88 07-03-90
DE-A-4226659	17-02-94	WO-A- 9404093	03-03-94